REMARKS/ARGUMENT

Regarding the Claims in General:

Claims 1-23 remain pending. Claim 1 has been amended to better highlight the distinguishing features of the invention. Claims 14-23 are withdrawn from consideration, but have been retained pending possible prosecution in a divisional application.

Regarding the Prior Art Rejections:

Applicants respectfully request reconsideration and withdrawal of the outstanding rejections. Although all the references disclose piezoelectric sensors, and two of the references are concerned with force measurements in semiconductor chip bonding apparatus, none of the references are directed to solution of the problem addressed by this invention.

In particular, the present invention is concerned with aligning a bonding tool designed to carry a semiconductor die so that the die is brought into contact with a surface to which it is to be bonded in substantially parallel relationship. As noted in the specification, alignment between the die and the contact surface must be within 16 microns. This is necessary to avoid cracking of the die, misplacement on the contact surface, and proper bonding.

The prior art cited by the Examiner is not concerned in any way with this problem. Sato U.S. Patent 5,985,064 (Sato), is concerned only with controlling the downward movement of the bonding tool to apply a precise bonding force between a chip or die to be bonded and the bonding surface (see Col. 1, lines 43-49). There is no disclosure, teaching, or suggestion in Sato of alignment of the bonding tool so that the chip contacts the bonding surface in precisely parallel relationship.

Mizutani, published Japanese application JP 2000-369072 (Mizutani) on the other hand, is concerned with accurate placement in a vertical orientation of a solid state image sensor. A cut edge is to be bonded to a package body 2, and the problem appears to be that the edge of the die might crack if it is not precisely perpendicular to the package surface, and the downward motion is not precisely controlled. To achieve the necessary control, Mizutani uses a laser displacement gage and a force sensor. Again, however, there is no disclosure, teaching, or suggestion in Mizutani of alignment of bonding tool.

The two Namerikawa et al. patents are even more remote. Neither is concerned with semiconductor chip bonding. Instead, these patents disclose sensors formed of a flexible plate which bears the sensing elements and a movable mass which is deflected by some external force such as acceleration or a magnetic force to deform the plate. The deformation stress in the flexible plate is measured by the sensing elements. Such a device is not capable of application to measuring compressive contact forces since bending of the flexible place is essential to the operation of the sensor. Such bending will not occur in devices such as disclosed in Sato and Mizutani, nor in the apparatus of the present invention.

These significant differences between the present invention and the cited prior art are clearly reflected in claim 1 as amended, which calls for:

> a force sensor configured to measure a force generated by the bonding tool on the force sensor,
>
> wherein the force sensor comprises a plurality of force sensing sections, each sensing section being adapted to individually detect an amount of force from a part of the bonding tool acting on that sensing section,
>
> the apparatus being responsive to the relative values of the detected forces to generate an alignment signal for adjusting the orientation of the bonding tool.

None of the references disclose, teach, or suggest an apparatus which is responsive to relative values of detected forces to generate an alignment signal for adjusting the orientation of a bonding tool.

It should also be noted that the Examiner's proposal to combine the teachings of either of the Namerikawa patents with Sato or Mizutani is not valid, even apart from the fact that the sensors of the Namerikawa patents can not function as compressive force contact sensors. Neither Sato or Mizutani require a sensor which measures anything but an absolute, i.e. net, force, and to substitute a multi-part sensor, even one which could function in the context of these devices, would simply be unnecessary.

Claims 2-13 are all directly or indirectly dependent on allowable claim 1, and are therefore allowable for the reasons stated above. In addition, these claim recite features which, in combination

with the features of their respective parent claims are neither taught nor suggested in the cited references, whether considered singly or in combination.

In view of the foregoing, favorable reconsideration and allowance of this application are respectfully solicited.

I hereby certify that this correspondence is being transmitted by Facsimile to (703) 872-9306 addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date indicated below.

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April 22, 2005
Date of Signature

LAH:gl

Respectfully submitted,

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